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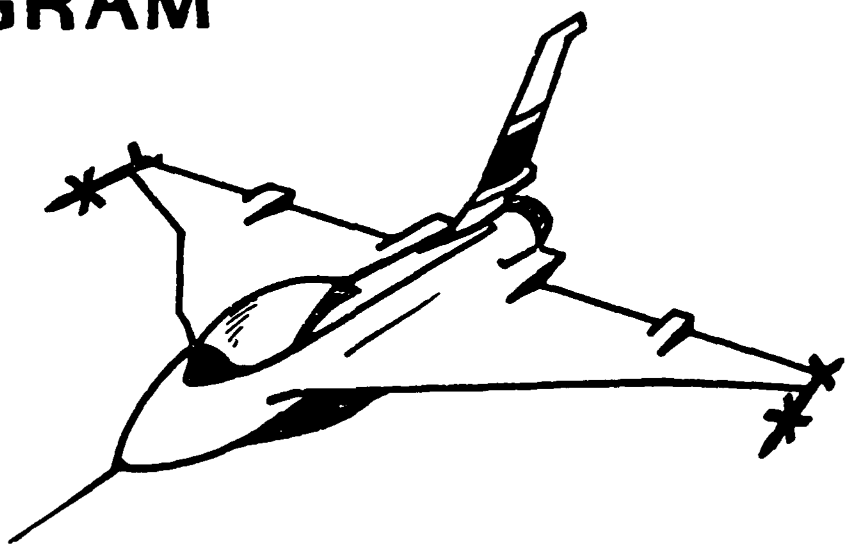
INDUSTRIAL TECHNOLOGY MODERNIZATION PROGRAM



FINAL TECHNICAL REPORT
CATEGORY 1 PROJECT
BLOCK FABRICATION IMPROVEMENTS

SEPTEMBER 28, 1984

INDUSTRIAL
TECHNOLOGY MODERNIZATION
PROGRAM

unclassified

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19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This project will investigate the mold assembly, epoxy resin mixing, block cutting and mold cleaning of countermeasures dispensers for improvement and automation.

This project will investigate and implement new capabilities in the following areas. These areas are: Pre-fabricated filler inserts, mix and pour work station with automatic resin dispensing, upgrade sawing method and revised layout. These improvements will enhance productivity through improved working conditions for the employees.

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Tracor Aerospace

September 28, 1984

RGL-84-09-15
Tracor Project 560

General Dynamics
Fort Worth Division
P. O. Box 748
Fort Worth, TX 76101

Attention: H. Patton, MZ 1400/Dept. 082
ITM Program Administrator

Gentlemen:

Subject: CDRL Item ~~002~~ 005 - Final Technical Report
Category 1 Project
Block Fabrication Improvements

Enclosed please find the Final Technical Report for the Block Shop Project.

Sincerely,

Ralph G. Leigh
Special Assistant to
Director of Contracts

RGL:pt

Enclosures

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Tracor Aerospace
Aerospace Austin

INDUSTRIAL
TECHNOLOGY MODERNIZATION
PROGRAM

FINAL TECHNICAL REPORT
CATEGORY 1 PROJECT
BLOCK FABRICATION IMPROVEMENTS
TRACOR PROJECT 560

28 September 1984

GENERAL DYNAMICS PURCHASE ORDER NO. 1005505

CDRL ITEM: ITM 004

SUBMITTED TO:

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Fort Worth Division
P. O. Box 748
Fort Worth, Texas 76101

PREPARED BY:

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BLOCK FABRICATION IMPROVEMENTS

SUMMARY

The objective of this project was to design, develop, and implement productivity improvements for the Magazine (Block) production area. The objective was accomplished through the development and implementation of new ideas covering prefabricated filler inserts, a mix and pour workstation, an upgraded sawing method, and revising the flow of the hardware through the Block Shop.

The countermeasures block fabrication shop produces dispenser magazines for the chaff and flare-type countermeasures systems. The blocks are honeycomb fiberglass dispensers which are fabricated by using a Tracor proprietary process. This method was quite labor intensive which required all the ingredients to be hand mixed, then poured, with complete disassembly required after curing.

Early in our Phase I effort, our analysis of our cost drivers indicated that the Block Shop was a good candidate for possible improvement. An analysis of the Block Shop focused on shop equipment and facilities. Data was collected through interviews and by direct observation of the shop operations.

The production process was studied in detail. The first step was to develop the present block fabrication process as a flow diagram (Figure 1) which assisted the project investigator in identifying potential areas for reducing cost. The areas identified for improvement were Mold Cleaning, Epoxy Resin Mixing, Shearing Operation, and Tooling Assembly and Disassembly.

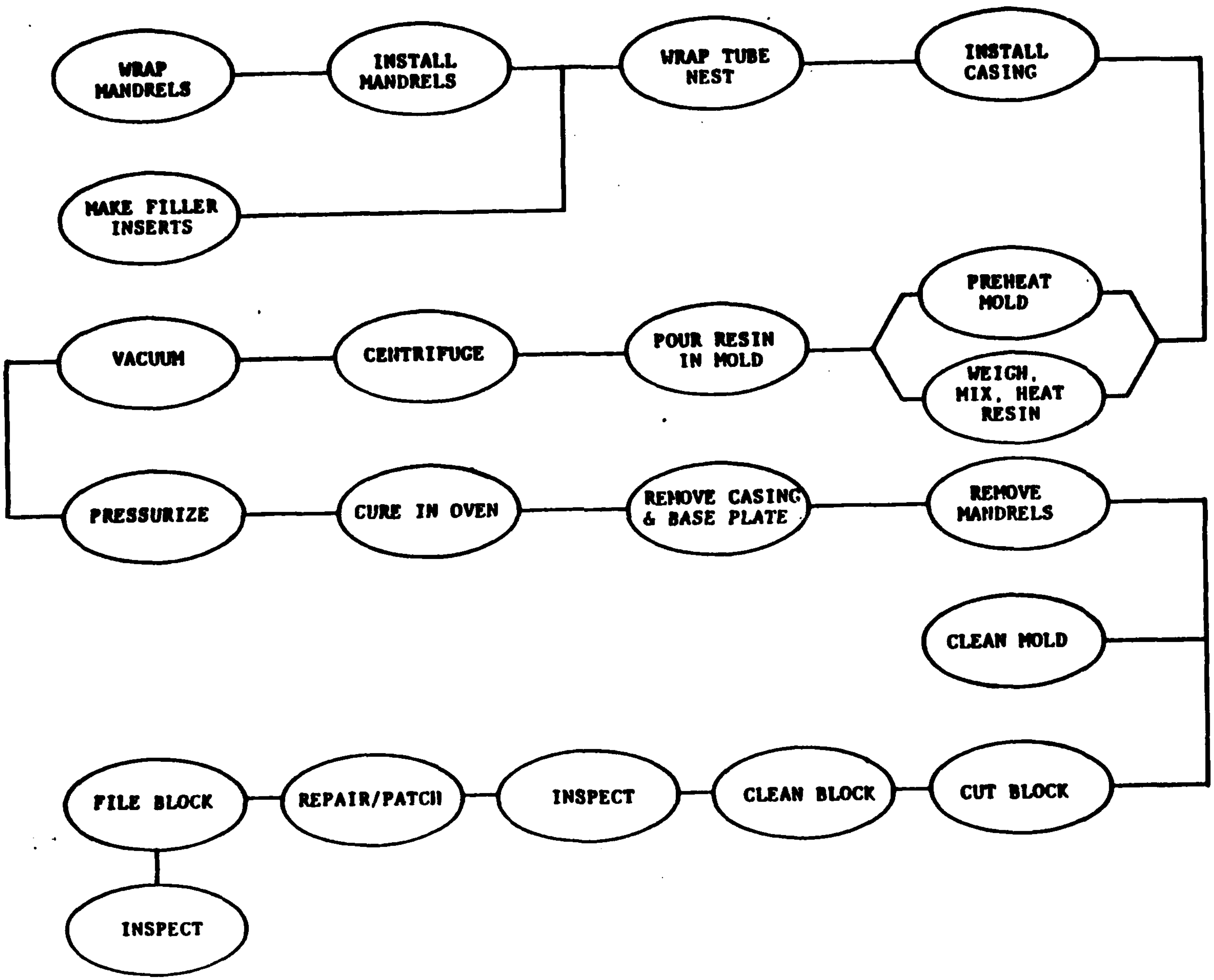


Figure 1. PROCESS FLOW CHART - BLOCK FABRICATION

ANALYSIS / WHY? / QUESTION EACH DETAIL

FLOW PROCESS CHART

NO ______ PAGE 1 OF 4

SUMMARY	PRESENT NO	PRESENT TIME	PROPOSED NO	PROPOSED TIME	DIFFERENCE NO	DIFFERENCE TIME
○ OPERATIONS						
⇨ TRANSPORTATIONS						
□ INSPECTIONS						
D DELAYS						
▽ STORAGES						
DISTANCE TRAVELED		FT.		FT		FT.

JOB 133686-0001 BLOCK

□ MAN OR □ MATERIAL ______

CHART BEGINS ______

CHART ENDS ______

CHARTED BY ______ DATE ______

DETAILS OF (PRESENT / PROPOSED) METHOD	OPERATION	TRANSPORT	INSPECTION	DELAY	STORAGE	DISTANCE IN FEET	QUANTITY	TIME	ACTION: ELIMINATE	COMBINE	CHANGE: SEQUE	PLACE	PERSON	IMPROVE	NOTES
	○	⇨	□	D	▽										
Wrap Mandrel	●	⇨	□	D	▽										
Temporarily Store Mandrels	○	⇨	□	D	▼										
Make Side Fillers	●	⇨	□	D	▽										
Prepare Fillers	●	⇨	□	D	▽										
Store Filler Temporarily	○	⇨	□	D	▼										
Prepare Mold	●	⇨	□	D	▽										
Install Mandrels & Piece Parts	●	⇨	□	D	▽										
Wrap Tube Nest	●	⇨	□	D	▽										
Install Casing	●	⇨	□	D	▽										
Delay	○	⇨	□	◗	▽										
Route to Oven	○	➡	□	D	▽										
Preheat Mold	●	⇨	□	D	▽										
Weigh, Mix & Heat Resin	●	⇨	□	D	▽										
Pour Resin in Mold	●	⇨	□	D	▽										
Trans B	○	➡	□	D	▽										
Centrifuge Block	●	⇨	□	D	▽										
Trans B	○	➡	□	D	▽										
Place in Vacuum Vessel	●	⇨	□	D	▽										
Trans B	○	➡	□	D	▽										
Place in Pressure Vessel	●	⇨	□	D	▽										
Plans B	○	➡	□	D	▽										
Cure in Oven	●	⇨	□	D	▽										
Remove From Oven	●	⇨	□	D	▽										

Figure 1 BLOCK FABRICATION PROCESS

FLOW PROCESS CHART

DETAILS OF (PRESENT / PROPOSED) METHOD	Operation	Transport	Inspection	Delay	Storage	Distance in Feet	Quantity	Time	Possibilities: Eliminate	Combine	Change: Sequence	Change: Place	Change: Person	Improve	NOTES
Remove From Oven	●														
Trans B		●													
Remove Casing & Base Plate	●														
Trans B		●													
Remove Mandrels	●														
Trans B		●													
Delay				●											
Clean Mold & Base Plate	●														
Route Mold & Base Plate To Assy		●													
Delay				●											
Cut Blocks	●														
Trans B		●													
Clean Blocks in Chlorothene	●														
Trans B		●													
Inspect Blocks			●												
Trans B		●													
Repair/Patch as Required	●														
Trans B		●													
Cure	●														
Route to Cleaning		●													
Delay				●											
File or Sand	●														
Plug Gauge	●														
True Position Gauge	●														
Envelope Gauge	●														
Engrave Trace No.	●														
Delay				●											
Trans B		●													
Q.C.			●												

Figure 1 BLOCK FABRICATION PROCESS

FLOW PROCESS CHART

DETAILS OF (PRESENT / PROPOSED) METHOD	OPERATION	TRANSPORT	INSPECTION	DELAY	STORAGE	DISTANCE IN FEET	QUANTITY	TIME	POSSIBILITIES: ELIMINATE	COMBINE	CHANGE: SEQUENCE	PLACE	PERSON	IMPROVE	NOTES
Route to Finishing Shop		●													
Receive & Verify Parts	●														
Trans B		●													
Delay				●											
Clean with Alcohol	●														
Mask and Plug Holes	●														
Trans B		●													
Apply Primer	●														
Trans B		●													
Dry in Oven and Air Dry	●														
Trans B		●													
Bondo Holes	●														
Trans B		●													
Dry in Oven and Air Dry	●														
Trans B		●													
Sand Bondoed Areas	●														
Remask if Necessary	●														
Trans B		●													
Apply Primer	●														
Trans B		●													
Dry in Oven and Air Dry	●														
Trans B		●													
Sand	●														
Trans B		●													
Apply Final Coat of Paint	●														
Trans B		●													
Oven and Air Dry	●														
Trans B		●													
Unmask	●														

Figure 1 BLOCK FABRICATION PROCESS

FLOW PROCESS CHART

DETAILS OF (PRESENT / PROPOSED) METHOD	Operation	Transport	Inspection	Delay	Storage	Distance in Feet	Quantity	Time	Possibilities: Eliminate	Combine	Change: Seque	Place	Person	Improve	NOTES
Check for Poor Paint			●												
Trans B		●													
Set up Silkscreening Station	●														
Ink Screen	●														
Raise Screen, Set Part Into Guidelines, Lower Screen Onto Part	●														
Run Squeege Over Screen	●														
Raise Screen, Remove Part and Place Onto Cart, Set Next Part Into Guidelines, Lower Screen	●														
Collect Excess Ink	●														
Clean Screen	●														
Repeat Process for 4 More Screenings	●														
Trans B		●													
Cure in Oven	●														
Trans B		●													
Apply Serial and Contract #	●														
Install 6 Studnuts	●														
Install 2 Rings	●														
Attach Retainer Plate	●														
Trans B		●													
Delay				●											
Q.C.			●												
Trans B		●													
Wrap Block	●														
Delay				●											
Trans B		●													
Storage					●										
TRANS A: Handling															
TRANS B: Transportation															

Figure 1 BLOCK FABRICATION PROCESS

Detail requirements were then developed, equipment specifications were prepared, equipment layouts and facility modifications were designed and equipment procured and installed. Final results were new capabilities in Block Fabrication for Pre-fabricated Filler Inserts, Mix and Pour Workstation, Upgraded Shearing Method, and a revised facility layout.

A cost/benefit analysis was then performed. The cost analysis showed that the block improvement payback period would be less than three (3) years with an internal rate of return of 19.65%. Total project cost was $89,203 with total savings of $152,238 over a four (4) year period.

A pert analysis (Figure 2) was used instead of a ICAM model. The pert network controlled the schedule and cost allowing us to submit our proposal as planned.

PERFORMANCE EVALUATION REVIEW TECHNIQUE (PERT)
OF BLOCK SHOP IMPROVEMENTS PROJECT

TASK NO.	ACTIVITY	PRED	TIME ESTIMATES			ET	σ^2
			a	m	b		
1	Review Schedule	0	1	1	1	1.33	.11
2	Define Production Requirements	1	1	1	3	1.33	.11
* 3	Define Current Capabilities	0	2	4	6	4	.44
* 4	Define Current Processes & Equipment	3	2	4	6	4	.44
* 5	Define Improvements	4,3,2,1	5	10	15	10	2.78
6	Define Tasks to be Performed	5	3	4	5	4	.111
7	Write Statement of Work	6	1	2	4	2.17	.25
8	Hold Kick-Off Meetings	7	-	1	-	1	0
8b	Research & Development Preliminary	6	5	10	20	10.83	6.25
9	Research & Development	8b,25	7	15	20	14.5	4.69
9b	Define Equipment/System Preliminary	5	5	10	15	10	2.78
10	Define Equipment/System Specification	9b	5	10	15	10	2.78
11	Interface with Suppliers/Contractor	5	90	105	110	103.33	11.11
*12	Evaluate Alternatives	5	30	40	50	40	11.11
13	Define Current Layout	0	2	2	3	1.83	.027
14	Prepare Preliminary Design	13,9b	1	2	4	2.17	.25
*15	Finalize Design	12,14	1	2	6	2.50	.69
*16	Draw Layouts/Schematic	15	4	5	10	5.67	1
17	Approve Production Delivery Schedule	0	-	1	-	1	0
18	Establish Cost Baseline	0	1	2	4	2.17	.25
*19	Identify All Cost Elements	9b,16	1	2	4	2.17	.25
*20	Identify Cost Savings	19,18	1	2	4	2.17	.25
21	Perform Financial Analysis	20,17	1	2	4	2.17	.25
*22	Prepare Phase III Proposal	13-20 5,8,9b,8b	3	4	5	4	.111
*23	Management Review	22	1	1	1	1	0
*24	Submit Proposal	23	2	2	3	2	.027
*25	Negotiate with USAF	24	5	10	15	10	2.78
*26	Select Equipment	10,25	8	10	15	10.5	1.36
27	Prepare Capital Equip. Justification	26	4	5	10	5.67	1
*28	Develop Implementation Strategy	26,16	4	5	10	5.67	1
29	Prepare Implementation Schedule	28	4	5	10	5.67	1
*30	Define Installation Procedures	28	4	5	10	5.67	1
31	Prepare & Issue Purchase Orders	29,27	4	5	10	5.67	1
*32	Perform Facility Improvements	30,29	5	10	15	10	2.78
*33	Receive & Install Equipment	32,31	30	40	70	43.33	44.44
*34	Debug & Evaluate	33	5	10	20	10.83	6.25
35	Train Personnel	33	3	5	10	5.5	1.77
*36	Prepare New Procedure	34	4	5	10	5.67	1
*37	Final Technical Report	36	10	15	20	15	2.77

KEY PRED - Predecessors
a - Optimistic Time
m - Most Likely Time
b - Pessimistic Time
ET - Expected Time
σ^2 - Variances of Activity Time

*Critical Path

Figure 2. PERT ANALYSIS

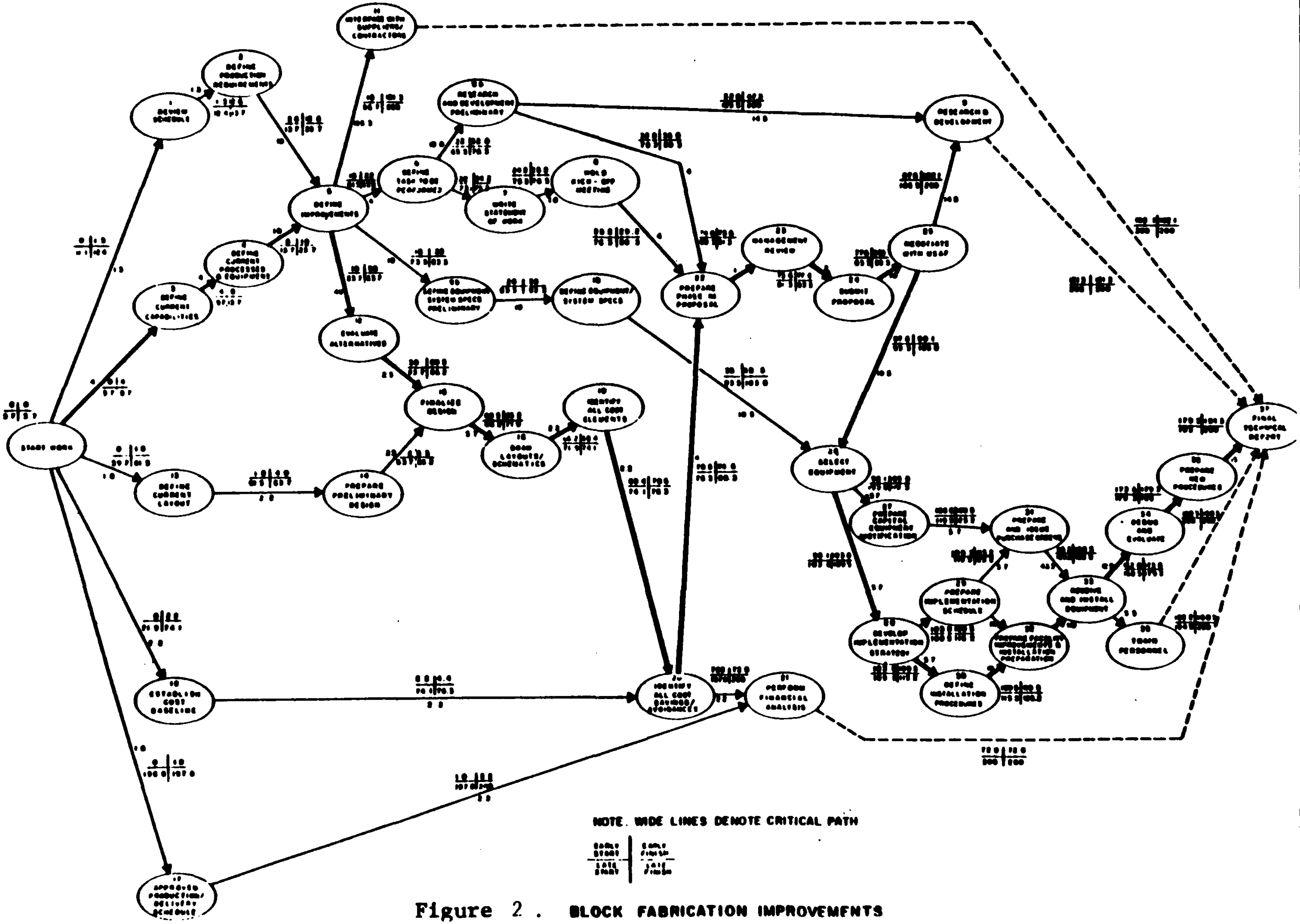


Figure 2. BLOCK FABRICATION IMPROVEMENTS

1.0 ORIGINAL BLOCK SHOP DESCRIPTION

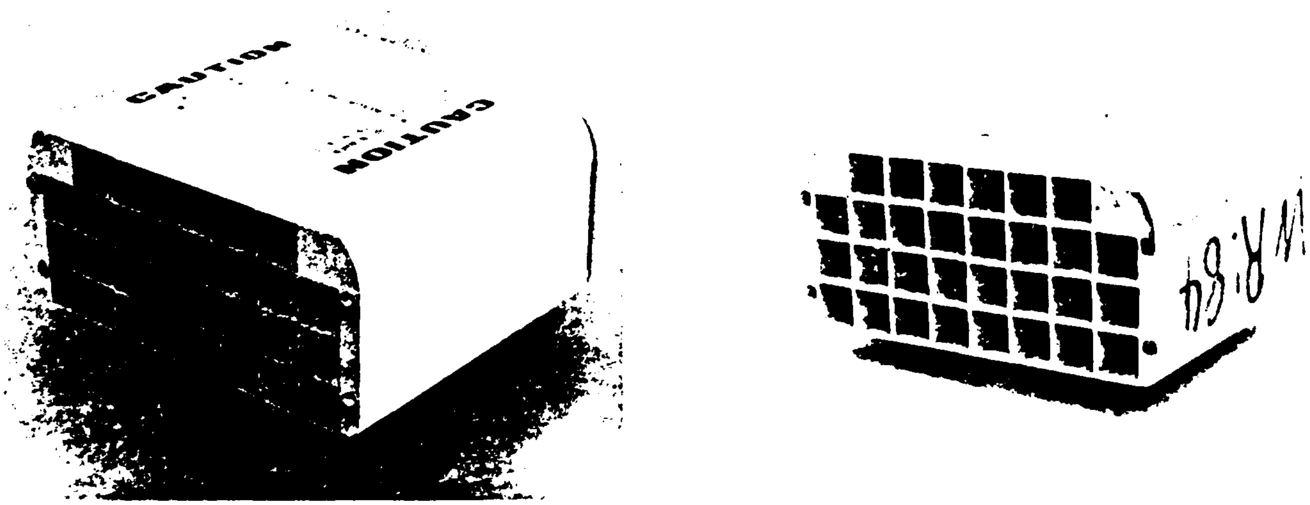
The Block Shop produces six (6) different configurations of dispenser magazines (examples are illustrated in Figure 3) which house chaff and flare payloads for Countermeasures systems. These magazines (blocks) are composed of molded fiberglass using a centrifugal casting and autoclave process. It is largely a manual process, from the fiberglass mandrel warpping to the extensive hand finishing of each block.

The Block Shop occupies approximately 2,800 square feet as the original configuration is shown in Figure 4. It is staffed with thirteen (13) production workers and one (1) supervisor.

Split among the different configurations of blocks, in batches from five (5) to fifty (50), the Shop produces a steady workload of approximately *400 blocks per month.*

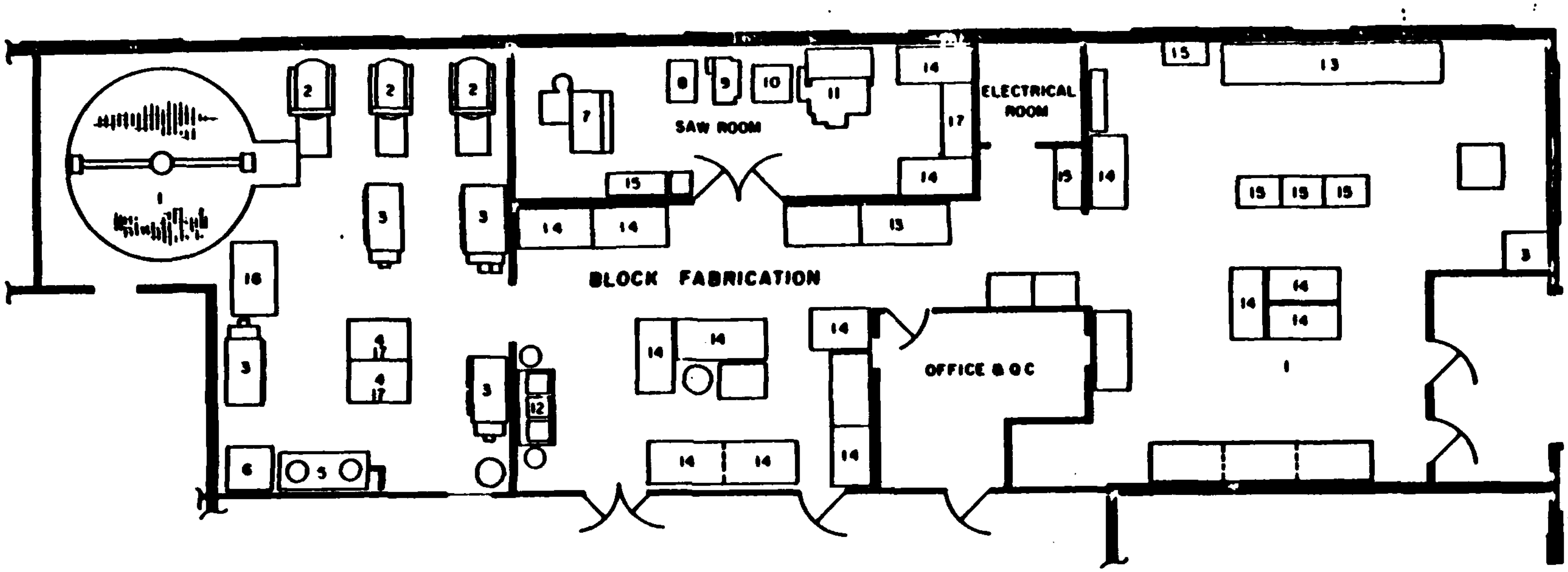
F16 CHAFF MAGAZINE

F16 FLARE MAGAZINE



F4 CHAFF MAGAZINE

Figure 3. COUNTERMEASURES MAGAZINES



BLOCK FABRICATION (EXISTING LAYOUT)

ITEM	DESCRIPTION
1 –	CENTRIFUGE
2 –	PRESSURE VESSEL
3 –	OVEN
4 –	MIXING TABLE
5 –	VACUUM BELL JARS
6 –	VACUUM PUMP
7 –	BEAD BLAST
8 –	BAND SAW
9 –	BELT SANDER
10 –	DUST COLLECTOR
11 –	SAW
12 –	SINK
13 –	WORK BENCH
14 –	TABLE
15 –	SHELVING
16 –	VENTED STORAGE
17 –	VENTED HOOD

Figure 4. ORIGINAL LAYOUT - BLOCK FABRICATION

2.0 TECHNICAL APPROACH FOLLOWED

2.1 Feasibility Studies

Feasibility studies were performed during the Phase 2 portion of the project with the following items accomplished:

- Evaluation of current procedures
- Identification of potential enhancements
- Evaluation of possible alternatives
- Identification of vendors and equipment available
- Estimation of costs versus savings

The studies showed that a new system was feasible and could provide, with low technical risk, a faster, more efficient method of producing countermeasures blocks. During this effort numerous vendors were contacted, which provided assistance for arriving at a final design. They are as follows:

Filler Inserts

- Fiberglass Industries, Inc.

Resin Dispensing

- IVEK Corporation
- H.S. Bancroft Corporation
- Amplan, Inc.
- Otto Engineering
- Ashby-Cross, Inc.

Shearing Operation

- Rex Machine Tool Company
- Norton Company
- American Saw and Mfg Company

Mix and Pour Work Stations

- Texas Restaurant Supply
- Texas Sheet Metal
- Kewanee Scientific Equipment Corporation
- Taylor Fume Hoods

Mold and Mandrel Cleaning

- INTEX Products, Inc.
- Fil-Clean Corporation
- Lewis Corporation

2.2 Current Procedures

"As is" capabilities, equipment, layout, and processes were documented in order to identify project candidates. Major operations of the labor intensive production process were defined as:

- Mold assembly/disassembly
- Filler insert fabrication
- Epoxy resin
- Block shearing
- Mold and mandrel cleaning

Mold Assembly and Disassembly - The current magazine molds are thick walled 661T6 aluminum casings assembled with swing and shoulder bolts (Figure 5). Six (6) to thirty (30), depending on the configuration, fiberglass wrapped mandrels or metal cores are individually installed onto a baseplate using

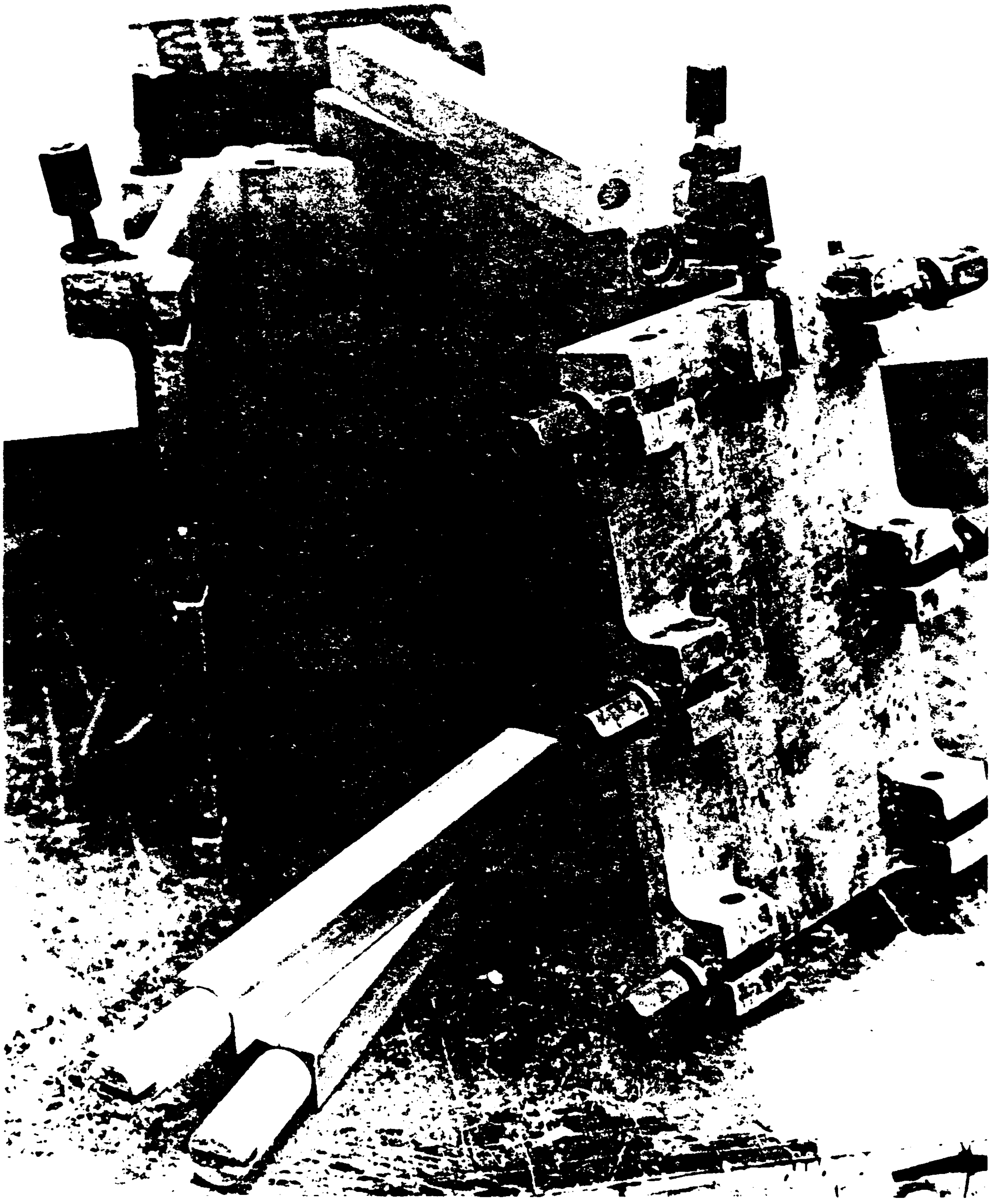


Figure 5. MAGAZINE MOLD

shoulder bolts. Four (4) mold casings and a baseplate are secured together using attached swing bolts. Removal of the block after the curing cycle requires complete disassembly of the mold and individual extraction of each mandrel.

Filler Insert Fabrication - Four (4) solid filler inserts composed of epoxy resin and chopped glass are required for each block (Figure 6). These fillers are made in batches of eight (8). The resin mixture and chopped glass are mixed and then poured into open molds. They are baked in an oven for 30 minutes, cooled, removed from mold, and bead blasted to remove any rough edges. Three (3) 9/32" diameter holes are drilled to facilitate resin flow.

Epoxy Resin Mixing - This process consists of individually hand measuring the resin , catalyst, and flexibilizer using a triple beam scale, combining all three ingredients into a stainless steel bowl and heating to the required temperature on a hot plate while stirring (Figure 7). Using this method consistent temperature levels and resin ratios are impossible to obtain.

Shearing Operation - A radial arm saw with a 16" diamond tip circular blade is used to dry cut blocks to length (Figure 8). The cutting stroke is sufficient but leaves no room for expansion of block cutting size. Also, the blade has a tendency to travel at the end of each cutting stroke making it difficult to achieve a precision cut, which periodically attributes to a secondary cut.

Mold and Mandrel Cleaning - The molds and mandrels used to cast blocks are presently hand cleaned using a cold paint stripper (Figure 9). They are soaked in the solvent for 10 minutes and then individually hand brushed to remove all

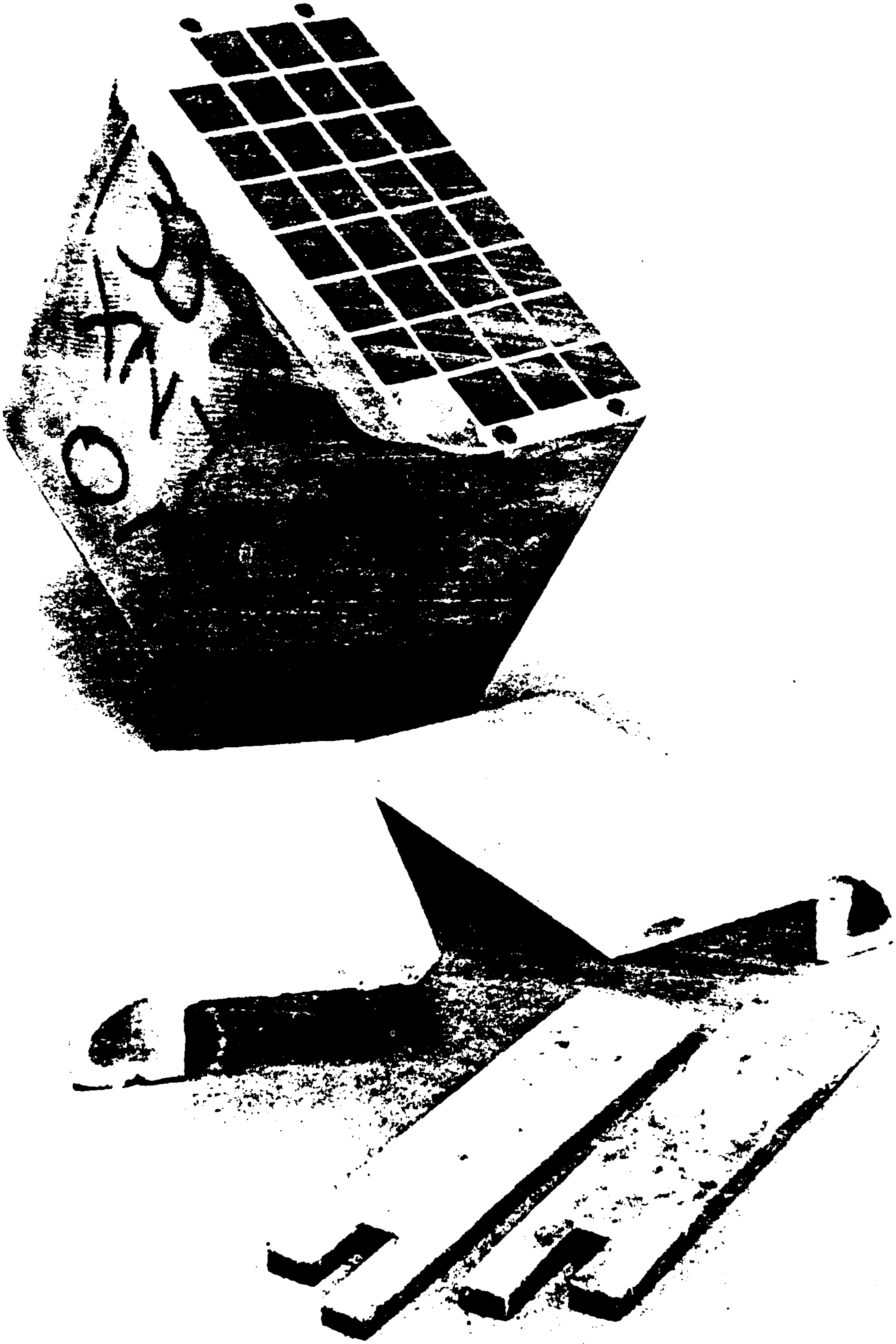


Figure 6. FILLER INSERTS

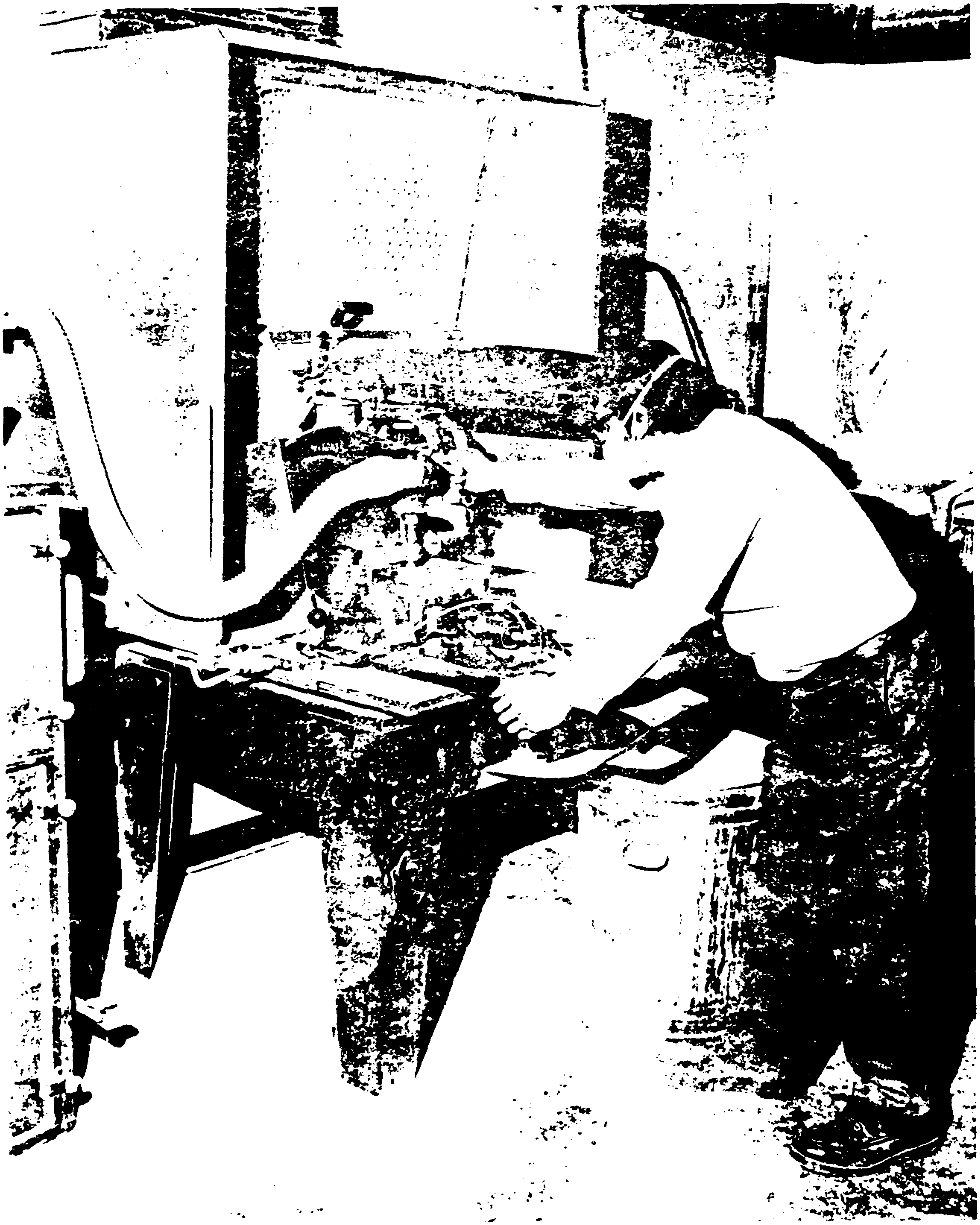


Figure 8. SHEARING OPERATION

Figure 9. MOLD AND MANDREL CLEANING

residues. This process is conducted after accrued buildup of the resins causes the molds to adhere to the blocks, approximately 100 labor hours per sixty (60) days.

2.3 Improvements Rejected

Several enhancements to the Block Shop were evaluated during the Phase 2 effort; however, they were not cost effective. The areas which were rejected from the Block Fabrication Improvement Project are as follows:

- Swingbolt system
- Mandrel to baseplate
- Mandrel removal
- Mold and mandrel cleaning

Swingbolt System - The present swingbolt system, although adequate, becomes difficult to assemble as resin collects around the swingbolt, causing breakage. A "split-hinge" and mounted wedge closure method in which the swingbolts would be replaced with a fixed tab were considered. This idea was rejected because close alignment of casings at assembly would be required and the time to retrofit this system would be twenty (20) hours/mold.

Mandrel to Baseplate - The mandrel-to-baseplate fastening system involves manually securing the mandrels to the baseplate using shoulder bolts. In trying to devise a fastener that would allow all mandrels to be inserted and extracted with only one operation, the use of Teflon was examined. Teflon's high coefficient of thermal expansion will secure the mandrel and the baseplate and seal against leakage. An aluminum stem with a Teflon band was screwed into the mandrel and then pressed into a taper-reamed hole to the baseplate. As the mold heated, the teflon expanded, sealing it, pulling the mandrel down onto the baseplate. However, the mandrels had a tendency to tilt due to side loading of the fiberglass wrap, causing Manufacturing Engineering to recommend discontinuing this idea.

Mandrel Removal - Presently each mandrel is pressed individually out of the mold using a hydraulic press. The use of tapered mandrels would permit all of the mandrels to be extracted simultaneously using a punch press. All new mandrels would have to be built since the current ones were built to the nominal dimension of .991/.990 and any reduction in size would cause gaging problems. The cost of building 900 new mandrels could not be justified.

Mold and Mandrel Cleaning - An ultrasonic cleaning system was investigated in order to reduce the labor-intensive process of furbishing magazine molds and mandrels. The ultrasonic cleaner incorporates the use of ultrahigh frequency sound to create pressure waves in a liquid bath. These sound pressure waves move through liquid, inducing cavitation. Using this cavitation process, along with a hot solvent, residues can be lifted from the Block mold surfaces. After experimentation with two (2) brands of ultrasonic cleaners, it was decided that ultrasonics would not remove the residues from the mold any better or faster than the current process. The molds still had to be individually hand-scrubbed.

As an alternative to an ultrasonic cleaner, a high-pressure water system was examined. Two (2) sample mold casings were tested with ineffective results using the strongest solvent. Also, the back spray presented a safety hazard, as the solvent material is hazardous even when diluted with water.

2.4 Proposal Improvements

Upon completion of our feasibility studies and current methods, new ideas were reviewed and presented to management with recommendations. These ideas covered old versus new methods, identification of potential vendors, and potential cost savings. Selected, to provide new capabilities in Block Fabrication, were:

- Pre-fabricated Filler Inserts
- Mix and Pour Workstation with Automatic Resin Dispensing
- Upgraded Sawing Method
- Revised Layout

Pre-fabricated Filler Inserts - The in-house fabrication of filler inserts was discontinued. A higher quality product called Format was proven to be more effective in preventing voids in the fiberglass mold. Format, a patented fiberglass mechanically bonded mat, will be procured in rolls and then cut to size.

Tracor also investigated the fabrication of a "similar to" mat and determined from its analysis that it would not be cost effective to pursue such an effort for the following reasons:

1) Since the mat is protected by a patent, fabrication of a likeness could be a problem

2) Developing a replacement would require an indeterminate amount of time.

3) A capital expenditure in the magnitude of $200,000 might be required to support mat fabrication.

4) At a material cost of $1.34 per magazine, amortization of the capital investment was not feasible.

Tracor's position is that it would be difficult, at best, to fabricate the desired matting and that the recovery rate of the Capital investment did not warrant further pursuit. Tracor therefore procured the product Format as an integral part of the Block Shop Improvement project.

The composition of this mat allows permeability of the resin, thereby requiring only two (2) inserts instead of the four (4) used in the current precess. This action will result in saving all the labor associated with the fabrication of the inserts and also decrease material costs by 30% to 36%.

Mix and Pour Workstation with Automatic Resin Dispensing - A combined mix and pour work station was constructed which included flow through ventilation required by safety when using epoxy resins (Figure 10).

The countertop of the pouring side of the workstation was recessed for ease of pouring into the open mold. After the pouring cycle, the completed mold is loaded onto an electric hoist for transport to the centrifuge.

A separate automatic dispenser was proposed which would regulate the catalyst. It would require a minimum of heat and mixing and require using a built-in hot plate and industrial stirrer. However, during the development of the system, problems with the crystalization of the catalyst became apparent.

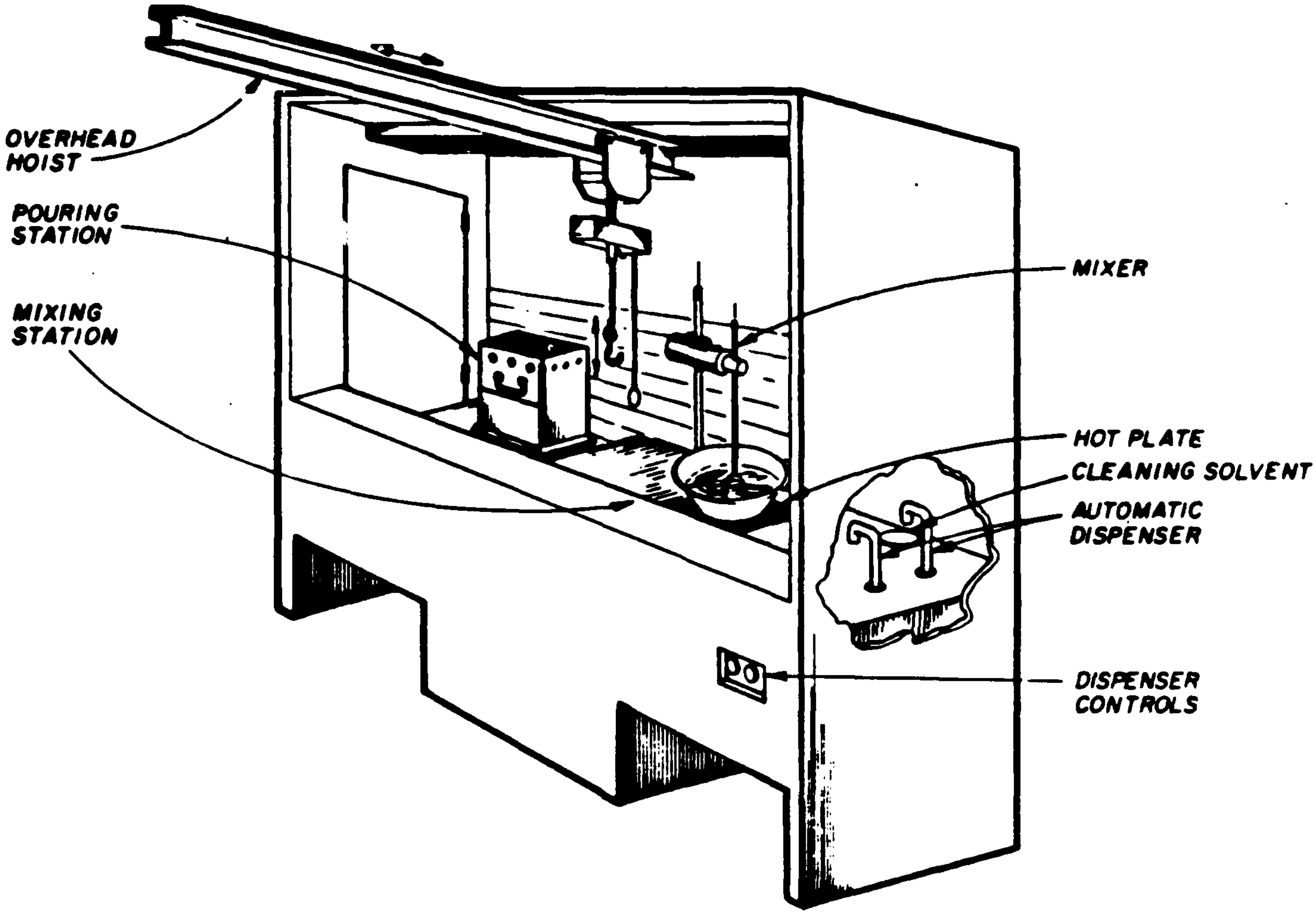


Figure 10 MIX AND POUR WORK STATION

In trying to establish the automatic resin dispenser the following problems were identified with the existing pumping/manifold system:

a. The pumps overload and shut off unless the resins are heated in the drum to 120°F or more.

b. The flexible hose from the pump to the manifold breaks and leaks under pressure, due to the thick viscosity of the resins.

c. The manifold breaks and leaks under pressure. It was much more difficult than previously assumed to pump through this system. To replace the PVC manifold with stainless steel would cost an additional $6,000.

Working with our vendor it was decided that if we purchased the catalyst in smaller quantities we could insure better process control and reduce crystalization. We could not eliminate the serious difficulties in pumping the catalyst through a piping sysem without having crystalization occur in the pipes. Consequently, we procured the catalyst in five (5) gallon containers enabling us to have better process control.

Although a dispenser system can certainly be built and implemented, the benefits are less certain. With the known problems of crystalization, maintenance could become a major problem. Fabrication Engineering therefore recommended, with Tech Mod concurrence, not to implement the proposed resin dispenser system.

Upgrading Shearing Method - A radial arm saw was previously used that had a 16-inch diamond tip circular blade to cut blocks to length. The cutting stroke was sufficient but left no room for expansion of the block cutting size. Also, the blade had a tendency to travel at the end of each cutting stroke, making it difficult to achieve a precision cut, which periodically required a second cut.

An upgraded shearing method was developed that included a cut-off saw with a 26-inch abrasion saw blade, holding fixture, and flood coolant system (Figure 11). The new equipment improved cutting accuracy, increased cutting size capacity, and controlled the fiberglass powder dispersion.

Revised Layout - A detail analysis was made of the flow of the hardware through the Block Shop. The existing process flow was examined (Figure 4) and a new layout was proposed. The mix and pour station, vacuum jars, ovens, and mechanical hoist were relocated to maximize flow efficiency. These new changes are illustrated in Figure 12. The original and new process flow is illustrated in Figure 13.

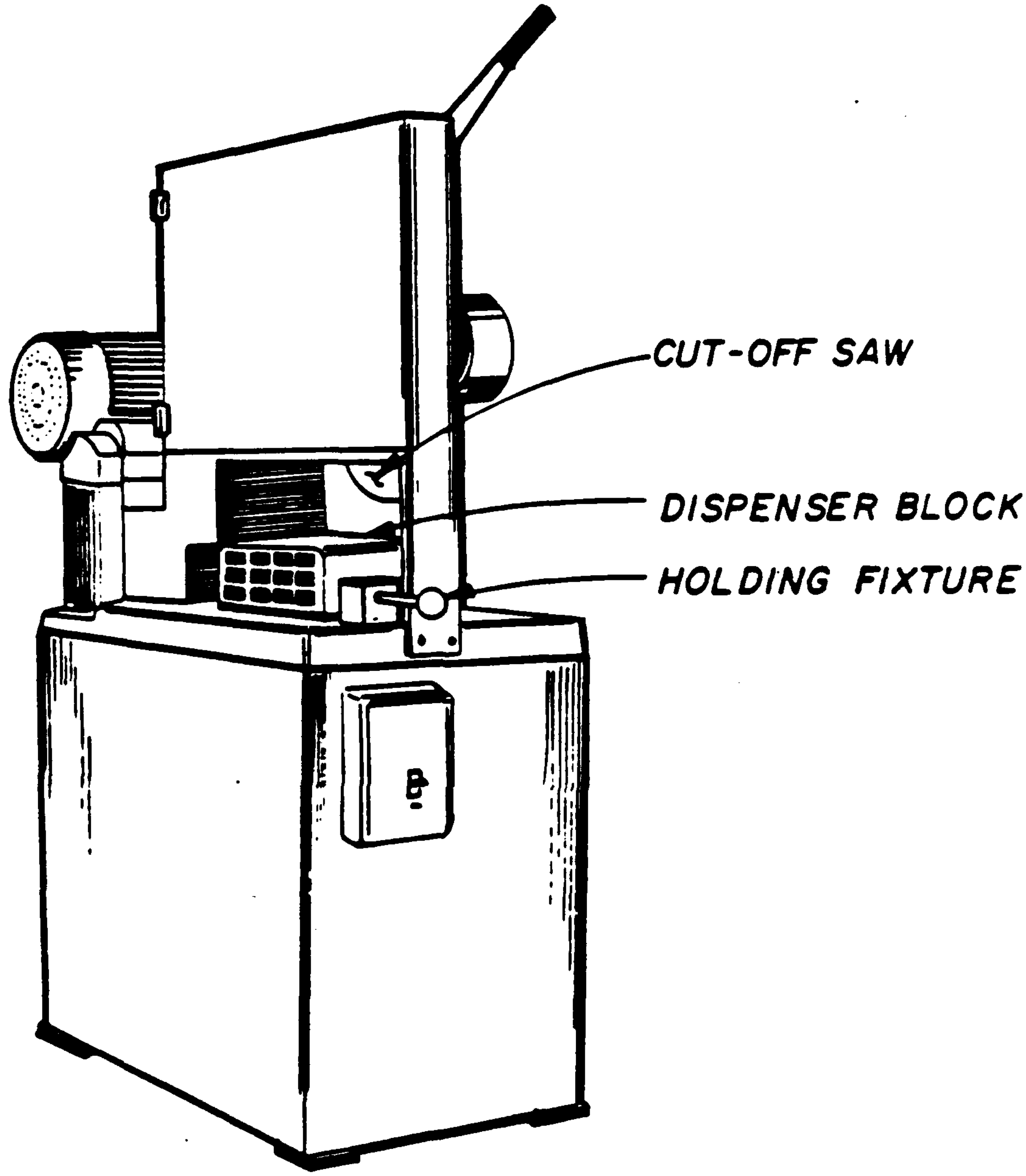
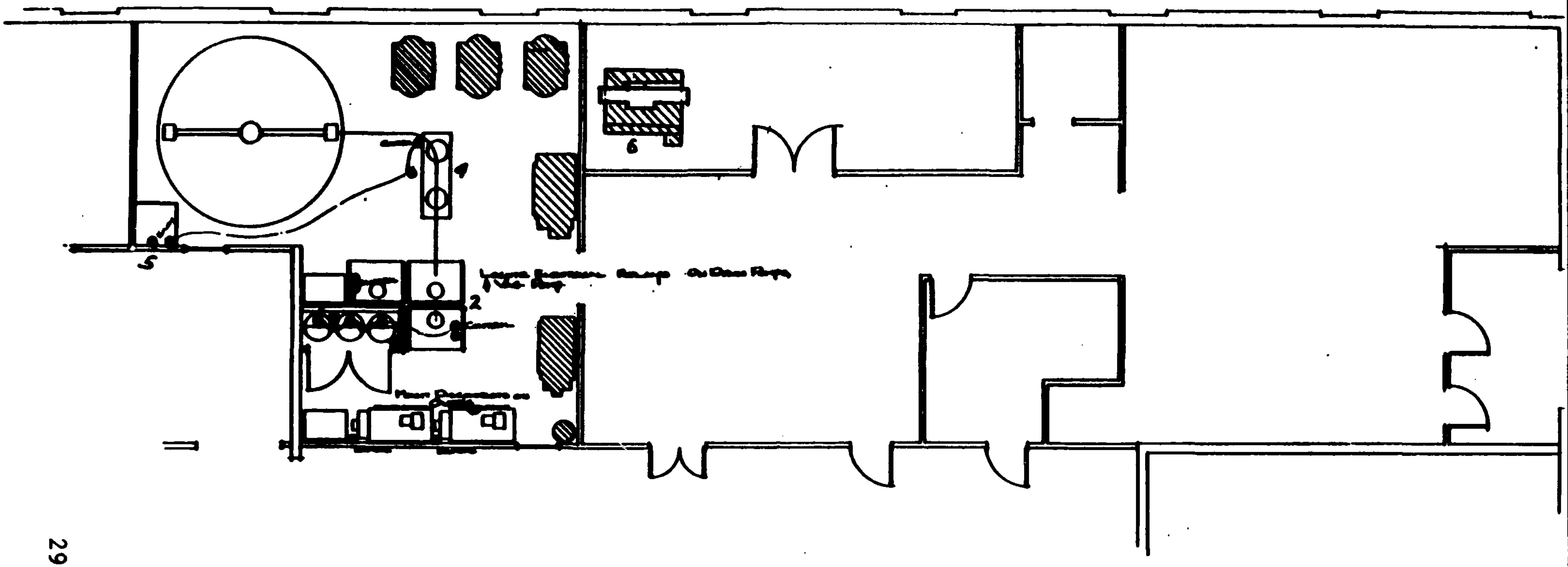


Figure 11 UPGRADED SAWING METHOD



1) MOVE 2 OVENS & VAC. JARS/PUMP TO NEW LOCATIONS (SEE SITE FOR PRESENT LOCATIONS)
2) MOVE 2 NEW MIXING TABLES & A POURING TABLE TO LOCATIONS SHOWN (REMOVE PRESENT TABLES)
3) WIRE ALL CONTROLS WHICH ARE REQUIRED ON EQUIPMENT
4) REPLACE TOP ON VAC. JARS TABLE
5) BUILD NEW BOX FOR VAC. PUMP
6) SET UP & WIRE NEW SAW

Figure 12. REVISED LAYOUT

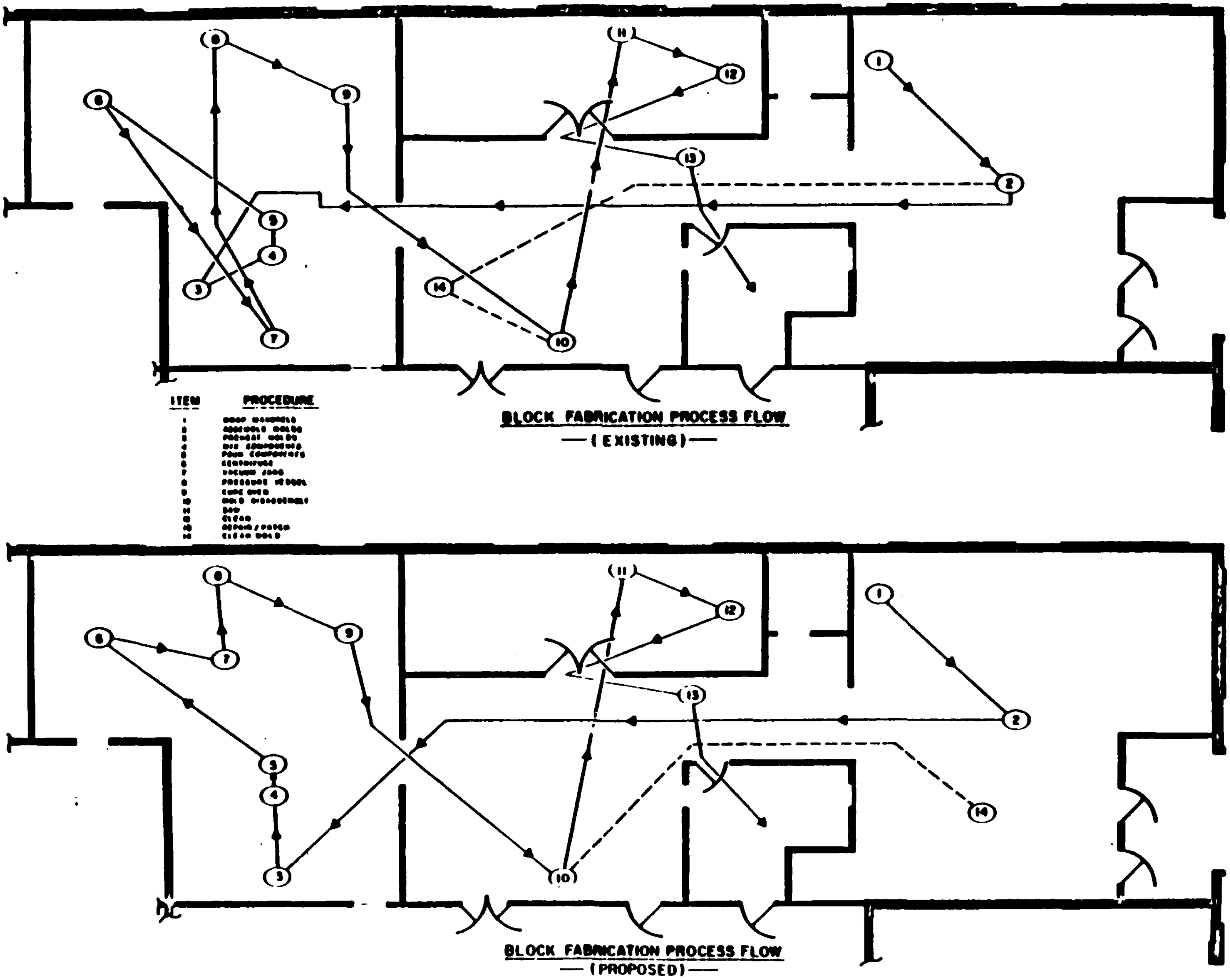


Figure 13. EXISTING AND PROPOSED PROCESS FLOW

3.0 PROJECT MANAGEMENT

The Project Investigator for this project was Rhonda Broussard, Industrial Engineer. She was supported by Tool Designers, Fabrication, and Quality and Design Engineering as required. She reported directly to the Industrial Tech Mod Program Manager. Her responsibilities included project management and cost, schedule, and technical conformances. The organization of the project is depicted in Figure 14 and an example of the Project Master Schedule, used in accomplishing the project, is shown in Figure 15.

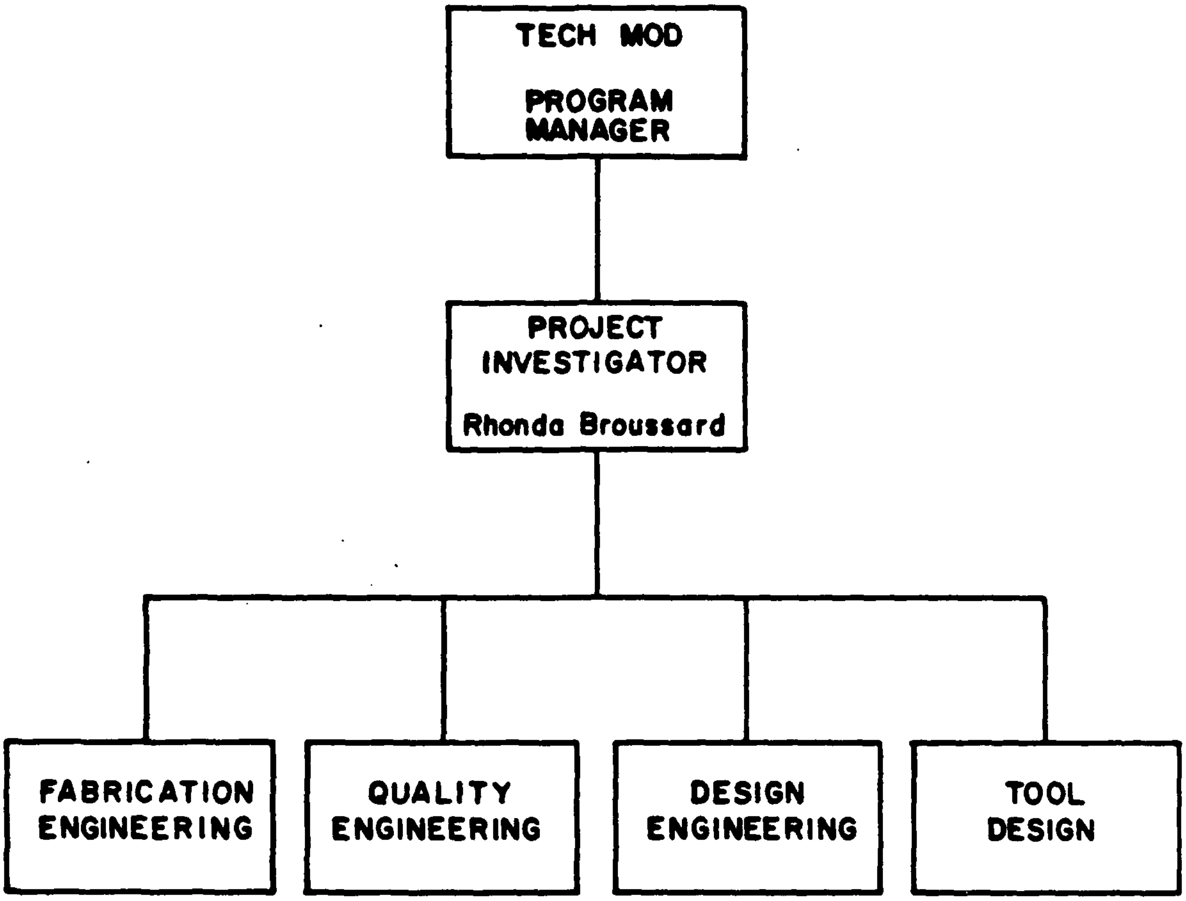


Figure 14 ORGANIZATIONAL CHART

PROJECT: Block Shop Improvements

PROJECT INVESTIGATOR: Rhonda Broussard

CHART TYPE: PROJECT MASTER SCHEDULE

REVISION DATE: 8/10/83 CHARGE NO.: 903-03

PAGE 1 OF 4

TASK	ACTION	MANHOURS BUDGET	MANHOURS ACT	"D" FIELD	DEC.	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT.	OCT.
TASK A - DEFINE REQUIREMENTS	PI														
(1) REVIEW SCHEDULE				01											
(2) DEFINE PRODUCTION REQUIREMENTS	PLM			02											
(3) DEFINE CURRENT CAPABILITIES	ME/BS			03											
(4) DEFINE CURRENT PROCESSES & EQUIPMENT				04											
(5) DEFINE IMPROVEMENTS				05											
(6) DEFINE TASKS TO BE PERFORMED				06											
(7) WRITE STATEMENT OF WORK				07											
(8) HOLD KICK-OFF MEETING				08											
TASKS B - PREPARE EQUIP/SYSTEM SPECS	PI														
(1) RESEARCH AND DEVELOPMENT	ME/TD/MS/DE/BS/QE			09											
(2) DEFINE EQUIP/SYSTEM SPECS	ME/DE/QE/FE/BS			10											
(3) INTERFACE WITH SUPPLIERS/CONTRACTORS	ME/BS/FE			11							24				
(4) EVALUATE ALTERNATIVES	ME/DE/QE			12											

*B - Buyer
BS - Block Supervisor
CA - Cost Accounting
D - Draftsman

DE - Design Engineer
*FE - Facility Engineer
FS - Facility Services
*GA - General Accounting

ME - Manufacturing Engineer
MS - Model Shop
*P - Proposal
PI - Project Investigator

PLM - Product Line Manager
QE - Quality Engineer
TD - Tool Designer
TMO - Tech Mod Office

*Overhead Functions

KEY

Λ - Number inside represents week of project.

Figure 15 PROJECT MASTER SCHEDULE

PROJECT: Block Shop Improvements | **CHART TYPE:** PROJECT MASTER SCHEDULE | PAGE 2 OF 4

PROJECT INVESTIGATOR: Rhonda Broussard | **REVISION DATE:** 8/10/83 | **CHARGE NO.:** 903-03

TASK	ACTION	MANHOURS BUDGET	MANHOURS ACT	"D" FIELD	MONTHS DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
TASK C - DESIGN SYSTEM/FACILITIES	PI														
(1) DEFINE CURRENT LAYOUT	D			13		▲									
(2) PREPARE PRELIMINARY DESIGN	ME/FE/ D			14		▲									
(3) FINALIZE DESIGN	ME/FE/ D			15			▲								
(4) DRAW LAYOUTS/SCHEMATICS	D			16			▲ ▲								
TASK D - COST BENEFIT ANALYSIS	PI														
(1) APPROVED PRODUCTION/DELIVERY SCHEDULE	PD/CO						▲								
(2) ESTABLISH COST BASELINE	CA/P			17			▲								
(3) IDENTIFY ALL COST ELEMENTS	CA/GA/ P			18			▲								
(4) IDENTIFY ALL COST SAVINGS/ AVOIDANCES	CA/GA/ P			19			▲								
(5) PERFORM FINANCIAL ANALYSIS	CA/GA/ P			20			▲ ▲								
TASK E - PHASE 3 PROPOSAL	PI														
(1) PREPARE PHASE 3 PROPOSAL	PI			21			▲								

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Figure 15 PROJECT MASTER SCHEDULE

PROJECT: Block Shop Improvements
PROJECT INVESTIGATOR: Rhonda Broussard

CHART TYPE: PROJECT MASTER SCHEDULE
REVISION DATE: 8/10/83 CHARGE NO.: 903-03

TASK	ACTION	MANHOURS BUDGET	MANHOURS ACT	"D" FIELD	MONTHS DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
TASK E - PHASE 3 PROPOSAL (con't)															
(2) MANAGEMENT REVIEW	TMO			22											
(3) SUBMIT PROPOSAL	TMO			23											
(4) FACT-FIND WITH GD	TMO			24				10		27					
TASK F - IMPLEMENTATION PLANS	PI														
(1) SELECT EQUIPMENT	ME/DE/ QE/BS			25											
(2) PREPARE CAPITAL EQUIP JUSTIFICATION	PI			26											
(3) DEVELOP IMPLEMENTATION STRATEGY	PI			27											
(4) PREPARE IMPLEMENTATION SCHEDULE	PI			28											
(5) DEFINE INSTALLATION PROCEDURES	FE/FS			29											
TASK G - PROCURE & INSTALL EQUIPMENT	PI														
(1) PREPARE & ISSUE PURCHASE ORDERS	B			30											
(2) PERFORM FACILITY IMPROVEMENTS AND INSTALLATION PREPARATIONS	FE/FS			31					14 11	16		26			
(3) RECEIVE & INSTALL EQUIPMENT	FE/FS			32					14	17		30			

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Figure 15 PROJECT MASTER SCHEDULE

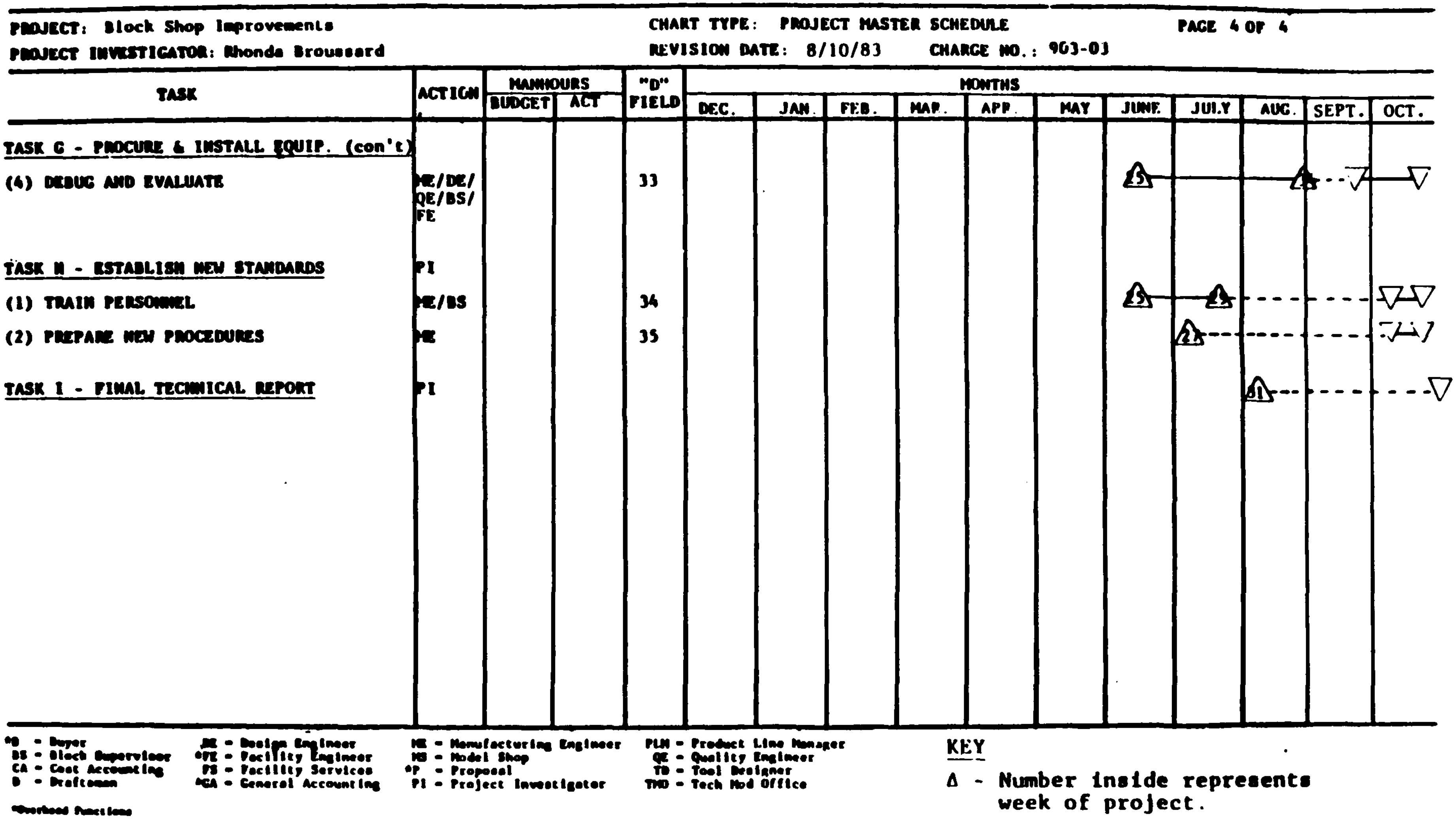

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Figure 15 PROJECT MASTER SCHEDULE

4.0 COST BENEFIT ANALYSIS

A detailed cost benefit analysis was made to document the anticipated savings to be accrued by implementing the entire Block Fabrication project. Time studies were conducted for each task performed. Savings were computed by comparing present and proposed times and then projecting those savings over the affected contracts.

It was the project strategy to compute the cost benefit analysis at the bottom line. Total costs and savings were calculated in order to make allowance for some improvements deemed necessary but with no "stand alone" savings. These improvements will have a positive impact on productivity through improved working conditions for the employees. To quantify this savings element, a variance formula was used. This variance was computed by arriving at the deviation from actual production run time and current time studies. This variance factor is applied to the existing estimated savings, thereby creating a total savings that represents contributions from all improvements.

The fiscal year savings were used to compute a project IRR of 19.65% by using an Interactive Financial Planning System (IFPS) software package from Execucom. Savings totaled $152,238 over four years. Labor savings is projected at 29.84 minutes per Block with material savings of $0.75 per Block. Total project cost was $89,203.